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Gagliardi

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[54] **INDUCTIVE COIL FOR HEATING A LOOP OF CONDUCTIVE MATERIAL**

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[52] **U.S. Cl.** **219/10.79,** 219/10.53, 156/275

[51] **Int. Cl.** **B23k 13/02**

[58] **Field of Search**.....219/10.79, 10.53, 10.43; 156/272, 275, 380, 381

[56] **References Cited**

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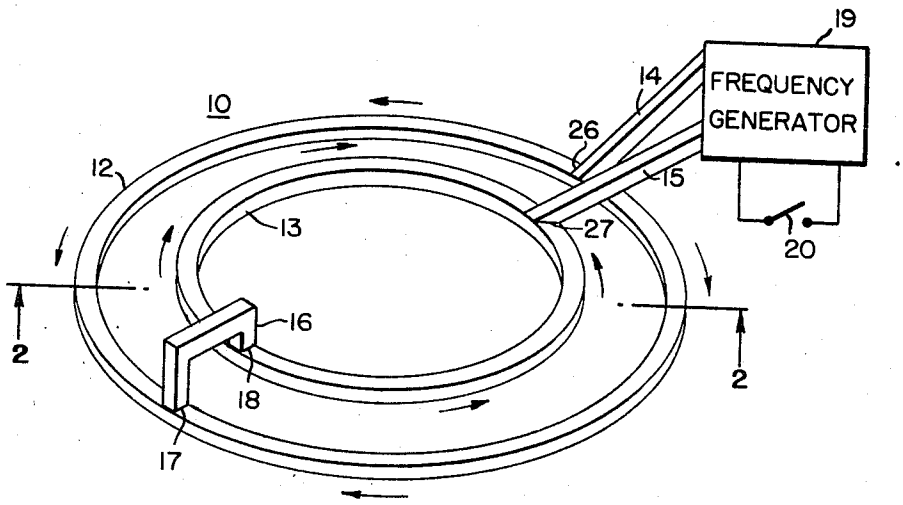
[57] **ABSTRACT**

An induction coil is provided for heating a loop of conductive material, the coil having first and second concentric closed inductive loops of different sizes to receive the loop of conductive material between them. Input leads are connected to the respective inductive loops and a jumper connects points on the inductive loops that are substantially at mid-positions respectively about the periphery of the associated inductive loops relative to the point of connection of one of the input leads. This provides a structure wherein current will flow through the loops in series and in opposite directions to provide uniform heating throughout a closed loop of conductive material.

3 Claims, 3 Drawing Figures



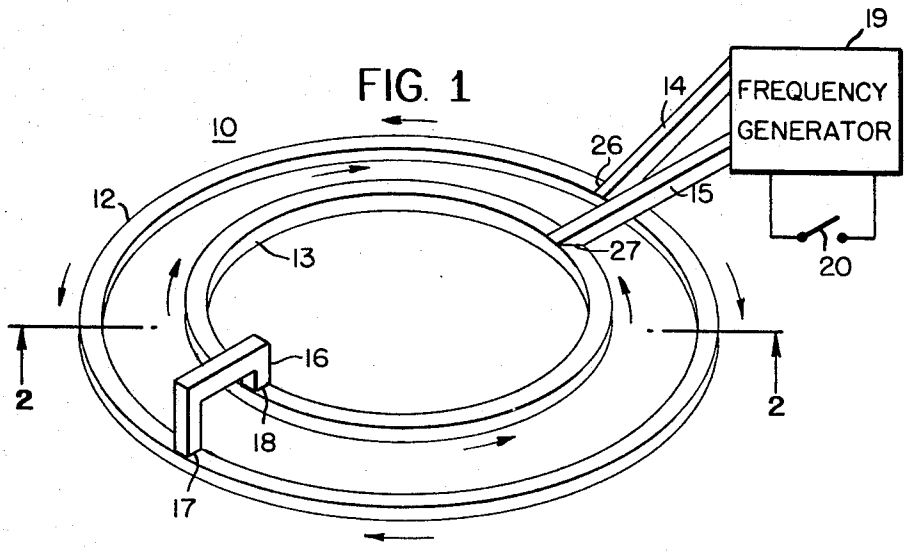


FIG. 1

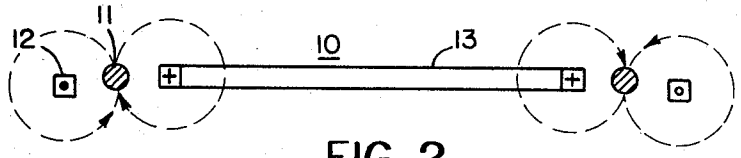


FIG. 2

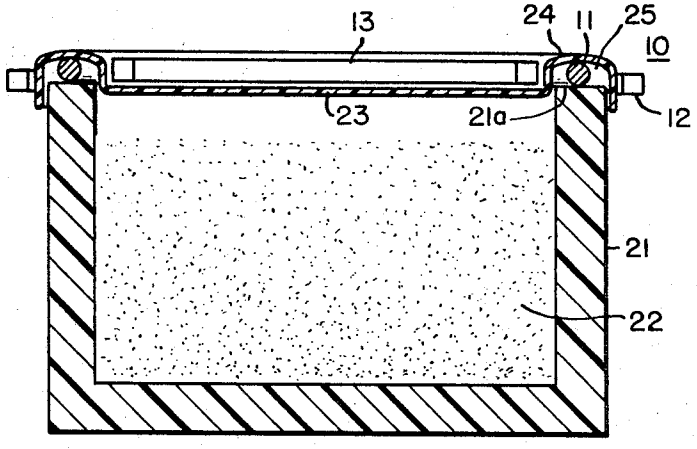


FIG. 3

INDUCTIVE COIL FOR HEATING A LOOP OF CONDUCTIVE MATERIAL

While this invention is subject to a wide range of applications, it is especially suited for an induction coil used in heat sealing plastic containers and will be particularly described in that connection.

Various systems for induction heat sealing of plastics are known in the art. One such application is for the heat sealing of plastic covers on plastic containers. This is accomplished by the heat sealing of a loop of conductive sealing material disposed between a cover and the top edge of a container. One of the difficulties encountered in these systems is to provide sufficient heating for a positive continuous seal of the cover and yet not provide heat damage for the materials within the container. One means for concentrating the heating in the sealing region is by the use of a metal flux concentrator surrounding a turn of an induction heating coil. Another system proposes to surround an area to be heated with a conductor formed in the shape of a bent hair pin adjoining the heating area so that current flows in opposite directions within the heating area. This has a disadvantage of poor distribution of heat because reduced heating is obtained in a gap at the end of the loop.

An object of the present invention is to provide an induction coil for heating a loop of conducting material that substantially obviates one or more of the limitations and disadvantages of the described prior art systems.

Another object of the present invention is to provide an improved induction coil for uniformly heating a loop of conducting material.

SUMMARY OF INVENTION

An induction coil is provided having first and second concentric closed inductive loops formed relatively larger and smaller in their periphery than a closed complementary loop of conducting material to be heated. Leads for connection to a source of power are connected to the respective inductive loops, and a jumper connects points on the inductive loops that are substantially at mid-positions respectively about the periphery of the associated inductive loop relative to the point of connection of one of the leads.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings, while its scope will be pointed out in the appending claims.

FIG. 1 illustrates an induction coil constructed according to one embodiment of the present invention;

FIG. 2 illustrates diagrammatically magnetic fields set up about a sectional view of loops of an induction coil taken along line 2—2 of FIG. 1; and

FIG. 3 is a sectional elevational view of an induction coil constructed according to FIG. 1, applied to the sealing of a cover on a container.

With reference to FIGS. 1, 2 and 3, an induction coil 10 is illustrated for heating a closed loop 11 of conductive material. First and second concentric closed inductive loops 12 and 13 are formed relatively larger and smaller in their periphery than the closed complementary loop of conducting material 11 to be heated. Leads 14 and 15 are secured to loops 12 and 13 respectively. A jumper 16 connects points 17 and 18 on the inductive loops 12 and 13 respectively that are substantially at mid-positions respectively about the periphery of the associated inductive loop relative to the point of connection of one of the leads 14 and 15 to the associated inductive loop.

The leads 14 and 15 are connected to the output of a suitable induction frequency generator 19 that can have its output controlled by a suitable control switch 20. The frequency generated by the induction frequency generator 19 may vary in accordance with the requirements of practice. A frequency of 5 mc has been found satisfactory for sealing plastic containers.

With reference to FIG. 3, an annular plastic container 21 is illustrated containing material 22 and having an annular cover 23. The cover 23 preferably has a raised peripheral edge 24 for cooperating with a top edge 21a of the container 21 to enclose an area 25 containing the loop of conducting material 11. The conducting material 11 may comprise bits of conductive metal such as iron and of plastic sealing material so that the conducting material and sealing material will flow when heated to form a seal between the rim 24 of the cover and the top edge 21a of the plastic container. The inductive loops 12 and 13 are disposed outside and inside respectively of the raised edge 24 of the cover. This concentrates a magnetic field generated by the two loops in the area of the loop of conducting material 11 as is illustrated in FIG. 2. Such concentration is provided particularly by causing current to flow in both directions around each loop as is illustrated by the arrows which illustrate instantaneous current direction in FIG. 1. In addition to concentrating a field in the area to be heated as is illustrated in FIG. 2, this arrangement also provides a means for cancelling out some of the field revolving about the loops at greater radial distances so as to minimize the heating of the material 22 within the container 21. This is particularly helpful where the material within the container may be of conducting material such that it would be damaged by induction heating.

The jumper 16 connects the loops 12 and 13 at points 17 and 18 which are diametrically opposite points 26 and 27 respectively of connection of leads 14 and 15 to the associated loops 12 and 13. This arrangement provides that substantially equal current will flow around the loops in both directions as indicated by the arrows so as to provide a substantially uniform heating throughout the periphery of the closed loop of conducting material 11. Such uniform heating permits the sealing of the cover 23 to container 21 securely with a minimum amount of heating being required.

The loops 12 and 13, together with the jumper 16 and the leads 14 and 15 are preferably formed of hollow material adapted for liquid cooling by passing fluid through the loops in series. This may be hollow square tubing as is illustrated in FIGS. 2 and 3.

While there has been described what is, at present, considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein, without departing from the invention, and it is, therefore, aimed in the appending claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An induction coil for heating a closed loop of conducting material wherein the improvement comprises,

a. first and second concentric closed inductive loops formed relatively larger and smaller in their periphery than a closed complementary loop of conducting material to be heated,

b. leads for connection to a source of power connected to the respective inductive loops, and

c. a jumper connecting points on the inductive loops that are substantially at mid-positions respectively about the periphery of the associated inductive loop relative to the point of connection of one of the leads to the associated inductive loop.

2. An induction coil according to claim 1 wherein the concentric inductive loops are disposed substantially in the same plane and have an area between the outer periphery of the inner loop and the inner periphery of the outer loop for heating a loop of conducting material that may be inserted between the inductive loops, whereby upon energization of the leads from a suitable source of high frequency, current will flow in opposite directions throughout the closed loops to concentrate a magnetic field created by the current flow throughout the loop of conducting material.

3. An induction coil according to claim 1 wherein the inductive loops, leads and jumpers are of hollow conducting material to permit passage of cooling fluid through the loops in series.

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